7.0 SAFETY RELATED PROJECTS AND PROGRAMS

Safety is our highest priority, and is a fundamental component of all Road Services Division Projects and Programs. This section highlights some of the projects and programs utilized by KCDOT in the ongoing effort to reduce the frequency and severity of collisions.

The Traffic Engineering Section manages many of these programs. An organizational chart for Traffic Engineering is included in Appendix C.

7.1. Roadside Safety

Run-off-road collisions were the most common accident type in 2003, and accounted for seven of the fourteen fatal accidents. The Countywide Guardrail Program focuses on locations with a high risk of these collisions. The goal of this program is to reduce the frequency and severity of run-off-road collisions by improving the roadside environment.

While barrier systems such as guardrail can shield vehicles from roadside hazards, they also present an obstacle that can be struck by vehicles. For this reason, barriers should only be installed where other measures (such as removing the hazard) are not feasible, and where the risk presented by the barrier is less than the hazard it is shielding. KCDOT assesses potential guardrail locations using a series of criteria established by the Washington State Department of Transportation (WSDOT). These criteria are referred to as guardrail warrants.[11]

7.1.1. New Installations

During the 1980s, KCDOT completed an inventory of roadways meeting guardrail warrants. As a result of this "roadside inventory," a guardrail priority array was established in 1988, and updated in 1995 and 2003[12]. There are currently 107 guardrail corridors on the priority array. Each year barriers are constructed on the corridors at the top of the list via the Countywide Guardrail Project.

Prior to installing a barrier system, each location is evaluated to see if meets WSDOT guardrail warrants. If feasible, the risk is mitigated by removing the hazard rather than installing a barrier. In addition to installing barriers, the Countywide Guardrail Program removes hazardous objects and widens shoulders to improve roadside safety.

The 2003 Countywide Guardrail Project installed 12,450 linear feet of guardrail at a total construction cost of $322,500. A portion of the design and construction costs were reimbursed through a federal Hazard Elimination System (HES) grant.

[11] WSDOT Design Manual, Chapter 700 and 710.
[12] King County Roadside Barrier Program, Priority Array Development, Phase 2. September, 2003.

7.1.2. Existing Barriers

King County currently has 1,822 barrier systems with a total length of over 550,000 linear feet. Over the past 20 years there have been significant advances in the design of barrier systems. As a result, older barrier systems are being recognized as a risk to motorists when compared with modern systems.

An inventory of all barrier systems within Unincorporated King County was completed during 2001. This inventory was used as the basis for the Retrofit Priority Array. The Retrofit Priority Array was completed in 2003, and ranks existing barriers that are in need of upgrading[13]. Upgrading of the barrier systems on this array is scheduled to begin in 2005.

Damage to existing barriers occurs primarily due to collisions and fallen trees. Damaged guardrails are repaired by the Roads Maintenance Special Operations crew, with design support from the Traffic Engineering Section. Damaged barriers that no longer meet current standards are either upgraded or replaced "in kind".

In addition to repair and upgrade of damaged systems, the Special Operations crew is also occasionally called on to remove barrier systems that no longer meet guardrail warrants. Many of these systems were installed prior to established warrants, or are at a location where the hazard has been removed.

7.2. HAL/HARS

King County maintains lists of High Accident Locations (HALs) and High Accident Road Segments (HARSs). The accident history, configuration, and operational characteristics are reviewed for each location on the HAL and HARS lists. This information is used to select, prioritize, and implement safety improvements.

Creation of a continually funded HAL/HARSs Program was proposed during 2002, and annual funding for the program began in 2003. The program is responsible for periodically updating the HAL/HARS list, managing and tracking safety improvement projects, and completing Before/After studies for completed safety improvement projects. The primary goal of the program is to address safety in the most cost-efficient manner by directing limited resources at the most effective improvements.

[13] King County Roadside Barrier Program, Priority Array Development, Phase 2. September, 2003.

7.2.1. 1996 HAL/HARS

During 2003, work continued on the 1996 HAL/HARS, which were based on accident data for the three-year period from 1992 through 1994. This list contains 100 HALs and 50 HARS. The status of these projects as of December 2003 is summarized in Table 7.

TABLE 7
STATUS OF 1996 HAL/HARSs

	Number of HALs	Number of HARSs	Total
Completed with Afterstudy	25	10	35
Completed	28	16	44
Construction	2	0	2
Design	5	3	8
Planned	7	6	13
Hold	1	0	1
Unfunded	4	0	4
No Recommendation	6	6	12
Annexed*	22	9	31
Total	100	50	150

Source: 1996 HAL/HARS Status Worksheet
** No longer in Unicorporated King County due to incorporation or annexation. Safety improvements were completed at some locations prior to incorporation/annexation.*

As indicated in this table, the majority of the 1996 HALs and HARSs have been completed, have no recommended improvement, or are now within incorporated areas. Twenty-three projects are in the planning, design or construction phase, and one is on hold pending design and construction by the City of Bellevue. The remaining four projects were unfunded as of December 2003.

7.2.2. 2002 HAL/HARS

A new HAL/HARS list was compiled based on 1998 to 2000 accident data, and a report with proposed improvements and priority ranking was completed in July 2003. The list contains 48 HALs and 51 HARSs. The estimated cost to complete all of the proposed improvements is $34,700,000. Thirty-one HALs and twenty-eight HARSs have been selected as cost-effective improvement projects based on benefit/cost analysis, with a total estimated cost of approximately $10,000,000.

A breakdown by project type and cost is provided in Table 8. Design and construction of 22 new projects began in 2004.

TABLE 8 2002 HAL/HARSs: PROJECT BREAKDOWN			
	Number of HALs	**Number of HARSs**	**Combined**
Breakdown By Project Type			
Previously Completed	11	13	24
Sign	3	3	6
Channelization	3	16	19
Signal	16	3	19
CIP	15	16	31
Total	**48**	**51**	**99**
Breakdown By Project Cost			
Previously Completed (N/A)	11	13	24
< $20k	7	18	25
$20-$100k	8	3	11
$100k-$1M	19	10	29
> $1M	3	7	10
Total	**48**	**51**	**99**

Source: High Accident Locations and Road Segments Analysis, July 2003.

7.2.3. Before/After Studies

Before/After Studies were completed for previous safety improvement projects at 25 HALs and 10 HARSs. The purpose of these studies was to assess the effect of the projects with respect to accident reduction and societal costs related to accidents. This information is useful in evaluating the HAL/HARS program, and to aid in selecting future safety improvements. Three years of "after" accident data were required for a location to qualify for a Before/After study, therefore the studies were limited to projects completed by December 1999. The findings are summarized in the following table.

TABLE 9 SUMMARY OF RESULTS - HAL/HARS BEFORE/AFTER STUDIES			
	HALs	**HARSs**	**Both**
Number of Afterstudies	25	10	35
Number w/ Lower Accident Rate	23	9	32
Number w/ Statistically Significant Reduction	19	9	28
Number w/ Higher Accident Rate	2	1	3
Average Reduction in Accident Rate	56%	64%	58%
Total Accidents Eliminated (Acc/yr)	66	63	129
Annual Reduction in Accident Costs[1]	$1,945,000	$1,736,000	$3,681,000
Number w/ Applicable Project Costs[2]	17	5	22
Average Project Cost	$180,206	$1,754,000	$537,886
Average Benefit/Cost Ratio	5.9	1.8	2.9
Annual Cost Savings[3]	$955,000	$404,000	$1,359,000

Source: Afterstudy Summary, 2003.

Notes
1. *The following costs per accident are used in this calculation: PDO-$6,000, Injury-$65,000, Fatality-$1,000,000*
2. *Excludes projects where a large portion of the cost would not address HAL/HARS issues (e.g. drainage, sidewalk, multi-intersection)*
3. *Reduction in accident costs minus annualized project cost.*

As indicated, the majority of the projects resulted in a reduction in the number of accidents. The 35 projects eliminated 129 accidents each year, and the estimated annual cost savings associated with the reduction in accidents is approximately $1,400,000.

The data was also broken down by improvement type so that the effect of different improvements could be assessed, and so that this information can be used when selecting future improvements. A breakdown by improvement type is provided in Table C9 (Appendix C).

7.3. Traffic Signals

When properly designed and operated, traffic signals are valuable devices for the control of vehicular and pedestrian traffic. Advantages of signals can include an increase in the capacity of intersections, a reduction in certain types of collisions (e.g. right-angle and left turn related collisions), and the ability to interrupt heavy traffic to allow access for vehicles or pedestrians on side streets.

However, signals are not a panacea for all traffic problems. Improper or unjustified signals can result in excessive delays, disobedience of signal indications; "cut-through" traffic on nearby roadways or through parking lots, and increases in the frequency of collisions (especially rear-end collisions).

For this reason, national standards are used to assess the need for signalization. These standards are referred to as signal warrants, and are contained in the Manual on Uniform Traffic Control Devices (MUTCD). There are eight signal warrants that are primarily related to vehicular traffic, but also include pedestrian use and collision data.

King County currently owns and operates 133 traffic signals. Annually, four to six new signals are constructed and three to eight existing signals are modified to provide operational and safety improvements. In 2003, six new traffic signals were constructed and four signals were modified.

7.3.1. New Installations

Traffic Engineering maintains a list of unsignalized intersections where signals are being considered, referred to as the Signal Priority Array. The Signal Priority Array includes locations meeting one or more of the MUTCD signal warrants as well as locations that are anticipated to meet signal warrants in the future. Locations are prioritized according to the signal warrants and their proximity to public schools.

New locations are added to the list at the request of citizens or staff, when significant development activity occurs in a specific area, or when new roadway connections are constructed. Traffic counts are collected and the signal warrants are reevaluated every 2 to 3 years for all locations on the list.

As of October 2004, there are 154 locations on the signal priority list. A total of 50 locations on the list meet one or more of the signal warrants. Twelve locations are currently funded for design and construction, and one is required for a development project.

There are several alternatives to signals, including roundabouts, construction of additional lanes, and realignment of road approaches, sight distance improvements, and restricting turning movements. In some cases, these alternatives may provide significant advantages when compared with signals. During preliminary design, locations on the signal priority array are evaluated for alternatives to signals, and a preferred alternative (not necessarily a signal) is selected.

7.3.2. Existing Signals

Improperly operated or poorly maintained signals can result in increased congestion or collision frequency. King County's traffic signals are monitored for maintenance and replacement needs, operational efficiency, and for signal upgrades such as protection for left-turn movements.

Maintenance and Replacement

Traffic Signal Technicians conduct preventative maintenance checks on all King County owned and operated signals every three months, and are on stand-by to respond all reports of irregularities. Annually, technicians check emergency vehicle equipment to ensure that all emergency vehicles can be detected as they approach the intersection and the traffic signal controller responds by providing a green indication for the approaching emergency vehicle. In addition, all incandescent signal indications and all luminaires at signalized intersections are replaced on an annual basis.

Priority lists for replacement of older signal equipment are currently under development.

Operations and Upgrades

As King County's population grows, existing signalized intersections can experience increases in congestion, delays and accident frequency.

Traffic counts and manual observations are used to evaluate signal operation, and signal phasing and timing is adjusted to optimize safety and traffic flow. Engineers and Technicians work cooperatively to ensure that each signal is operating efficiently and with minimal delay to all approaches. As areas become congested, this process is imperative to address driver frustration and minimize disobedience to signal displays.

The HAL/HARS program monitors locations for accident frequency and recommends improvements. Changes involving signals are then evaluated by the Signal Program, and implemented as appropriate.

The addition of left-turn signal phasing[14] can result in significant reductions in collisions when used at appropriate locations. For example, a before/after study indicated that the accident rate at the intersection of 116th Avenue SE and SE Petrovitsky Road decreased by 58% after left turn phasing was added. However, improper use of left turn phasing can also increase congestions and collisions, and therefore this improvement must be carefully evaluated. King County uses a formula know as the Left-Turn Product Warrant to evaluate left-turn phasing.

Another safety upgrade is the replacement of incandescent signal heads with light emitting diode (LED) signal heads. LED signal heads are more reliable, and improve safety by reducing signal down time. These signal heads also use approximately one-third of the energy, resulting in substantial cost savings. The County replaces incandescent signal heads when maintenance is required, and has requested funding for a countywide replacement program in 2005.

7.4. CIP Projects

Many of the Road Services Division's Capital Improvement Program (CIP) projects are directly related to safety. These include projects recommended to the CIP by the HAL/HARS program as well as projects to address locations where other potential safety issues have been identified. Most of the remaining CIP projects also have a safety component. For example, bridge replacement projects frequently include upgrades to guardrail and other safety improvements, while the primary purpose of these projects is usually infrastructure preservation.

Thirty-seven CIP projects were completed in 2003, while design continued on forty-eight additional projects.[15]

The ten arterials with the highest accident rates are listed previously in Table 5 (Section 6.3) of this report. Table 10 compares these arterials with CIP and other safety projects.

[14] Left turn signal phasing uses a "green arrow" signal head and provides a "protected" movement for left turning vehicles.

[15] The number of projects in design is based on information as of December 2003. Since that time, the CIP has been revised due to funding reductions, and a number of projects have been dropped.

TABLE 10
ARTERIAL ROADWAYS WITH HIGHEST ACCIDENT RATES
COMPARISON WITH CIP PROJECTS

Rank	Roadway	CIP Project	Status
1	S 120th St	300400	Completed 2002
2	SE 128th St	Traffic[1]	Completed 2002
3	S 118th St	Traffic[1]	Construction 2004
4	S 321 St	301200	Completed 2002
5	Military Rd S	Ped[2]	
6	34th Ave S	Ped[2]	
7	78th Ave S, S 112th St, 80th Ave S, Lkrdg Dr	Ped, Dev[2,3]	
8	148th Ave SE	Dev[3]	
9	17th Ave SW, 16th Ave SW, W/C Cutoff	None	
10	NE 80th St	None	

Notes 1. Traffic Engineering Safety Improvement Project (non-CIP)
2. Ped = Pedestrian Projects
3. Dev = Developer Projects

As indicated in this table, no safety improvement projects are currently planned for two of the ten arterials. In addition, the pedestrian safety and developer projects planned for four of the arterials are unlikely to significantly reduce the accident rate.

Review of these six arterials for possible safety improvement projects is recommended in Section 8.

7.5. Traffic Signs

Properly designed and maintained traffic signs are a critical part of roadway safety. Conversely, inappropriate, excessively used, or poorly maintained signs can result in driver confusion, excessive delays, or increased collisions. For this reason, the Manual on Uniform Traffic Control Devices (MUTCD) establishes national standards for the design and placement of signs. The MUTCD also provides warrants, or criteria, for the installation of certain types of regulatory signs such as all-way stop signs.

To be effective, signs and other traffic control devices should fulfill a need, command attention, convey a clear simple meaning, command respect from road users, and give adequate time for proper response.[16] All proposed sign installations, removals, and relocations are designed by engineers from the Traffic Engineering Section, and are reviewed for compliance with MUTCD standards and generally accepted engineering practice.

[16] MUTCD, 2000

The Traffic Operations Unit is responsible for sign installation on arterial roadways, while the Neighborhood and Pedestrian Unit is responsible for non-arterials. During 2003, 800 sign-related work orders were issued.

KCDOT owns and maintains approximately 46,000 signs. Over time, signs lose their reflective properties from exposure to sunlight and dirt. In addition, they can be damaged due to collisions or vandalism. For this reason, Traffic Maintenance technicians inspect all signs on an annual basis. This includes a sign verification/night check to determine if signs are missing or if new signs that are not in the database have been installed. Signs are cleaned, repaired, and replaced as necessary based on the inspections and reflectivity testing.

The most recent update of the MUTCD establishes compliance dates by which agencies are expected to meet new standards for certain types of signs. In 2003, KCDOT began a corridor reconstruction program to evaluate all signs on arterials for MUTCD compliance.

7.6. Pedestrian Projects

Reported pedestrian collisions are infrequent, but receive special attention due to their severity. Pedestrian collisions comprised 1.4% of the accidents during 2003. A total of 39 collisions occurred, with an estimated cost of $3.4 million. 97% of these collisions resulted in injuries or fatalities.

Many jurisdictions rate pedestrian improvements along with other road projects. However, such systems are often biased towards motor vehicle improvements at the expense of pedestrian facilities. For this reason, KCDOT has a separate program that provides funding for pedestrian safety improvement projects.

The Pedestrian Pathway Prioritization (3P) Program, also referred to as the Pedestrian Safety and Mobility Program, designs and constructs improvements specifically for pedestrians and other non-motorized users. This program is managed by the Traffic Engineering Section, and funded through the CIP.

7.6.1. Prioritization

As with all transportation sectors, funding for pedestrian improvements is usually inadequate to satisfy all of the needs. For this reason, a priority process for pedestrian improvements has been established. The 3P rating process was first developed in 1990, and has since been revised to better reflect changes in design standards, County policy, land use, and public desires. The process consists of four components: Identification, Screening, Scoring, and Evaluation.

Initial identification of projects is provided by a number of different sources, including King County staff, citizens, businesses, community groups, and schools. Solicitation forms are distributed at community meetings, public hearings, and other public gatherings, or mailed directly to citizens known to have an interest in pedestrian safety. Press releases or public service announcements have shown to be very effective in generating responses.

Locations are field-checked and screened to eliminate those that are judged to be unjustified or infeasible. In some cases, projects are referred to other programs such as the School Pathway Program or the CIP. A preliminary scope of work and cost estimate is completed, and the projects then move on to the scoring phase.

Projects are scored based on traffic volumes, speed, land use, existing roadway conditions, collisions, and project cost. After projects are scored, those scoring the highest undergo final evaluation. The scores themselves may not account for certain considerations such as political and environmental feasibility. For this reason, some projects may need to be further scrutinized during this evaluation phase.

7.7. School Pathways

King County continues to focus on improving walking routes for elementary, middle, and high school students living in unincorporated areas. In many cases, the projects are small in scale, but the payoff is huge – making the walk to school safer for all kids.

The School Pathway Program is a collaborative effort between King County and the county's 16 public school districts and dozens of accredited private schools. Each district submits a list of potential pathway projects based on their prioritized needs. Projects are selected based on the priority rating given by the school district, and include factors such as cost, location, size and feasibility.

7.8. Safety Investigations

Traffic safety investigations include speed limit studies, no parking requests, sight distance concerns, requests for illumination, intersection operational improvements, installation of signing, traffic control and the installation of flashers. In most cases safety investigations are completed to respond to citizen requests or to provide information needed for road improvement projects.

The Traffic Operations Unit is responsible for safety investigations on arterial roadways. On non-arterials, the Neighborhood and Pedestrian Unit completes them. In most cases, these units are also responsible for completing any improvements recommended by the investigations.

During 2003, the Traffic Engineering Section completed approximately 640 traffic safety investigations.

7.9. Enforcement

Targeted enforcement can dramatically improve safety in problem areas by reducing speeding and other illegal driving behavior, and by educating motorists on safe driving practices.

The Selective Traffic Enforcement Plan (STEP) is a collaborative program bringing together the resources of two King County departments: the Sheriff's Office and the Department of Transportation. STEP deploys uniformed, motorcycle police officers on selected roadways in unincorporated King County. The program also provides radar reader board speed displays at selected locations.

Law enforcement and traffic engineers analyze current and historical data on accidents, traffic speeds, chronic traffic problems and citizen complaints to identify problem areas for STEP. During 2003, STEP officers issued over 2,600 warnings and 6,900 citations with a total of nearly $900,000 in fines.

Appendix D contains a copy of the STEP brochure that further describes the program, and the 2003 monthly summary reporting of hours spent, number of citizen contacts, number of warnings and citations issued and the revenue generated.

7.10. Neighborhood Traffic Safety

The Neighborhood Traffic Safety Program (NTSP), in cooperation with the Sheriff's Office to address growing concerns within the residential areas of unincorporated King County. This program offers a wide range of services to address the traffic safety concerns within those neighborhoods.

The number one concern of residents is vehicle speeds. There are several general reasons for speeding. Residents drive faster on their local streets because they feel familiar and comfortable. Outsiders use local streets as short cuts to busy arterial roads. Speeding increases the risk of collisions, and is of particular concern with respect to children and elderly people.

The NTSP provides a variety of tools to address speeding and cut-through traffic problems. The program has two traffic enforcement officers tasked with speed enforcement within the residential areas. The officers act both to deter speeders and to educate motorists on safe driving practices.

NTSP staff engineers hold neighborhood meetings to discuss the causes of speeding and approaches to reducing it. One tool that can be used as a result of the meetings is a sign with the message "Please drive Carefully, For Our Children's Sake, 25 mph". These

signs are placed in neighborhoods after a pledge has been signed by the residents to obey the posted limit.

7.11. Collision Records

Traffic collision data is used regularly throughout Traffic Engineering, and is a primary source of information for this report, and for many Road Services programs, including the HALS/HARS, CIP, Signal, Guardrail, and Safety Investigation Programs. In addition, state law (WAC 308-330) requires local agencies to maintain collision records for at least the most current five years.

Traffic Engineering's Data Analysis Group maintains traffic collision records in database form dating back to January 1, 1984. The Washington State Patrol initially provided collision data. However, the State Patrol encountered technology problems while attempting to convert to a new data acquisition system, and has been unable to provide this data for collisions occurring after 1996. Due to the critical nature of this information, King County DOT's Data Analysis Group has completed data entry for collisions occurring between 1997 and 2003, and is in the process of entering 2004 collision data.

The Washington State Patrol is developing a Web based application to allow local agencies to automatically download collision data. However, this system is not yet operational. King County is developing an application to import the state data. However, this application is still in the development stages and is not anticipated to be operational until mid 2005.